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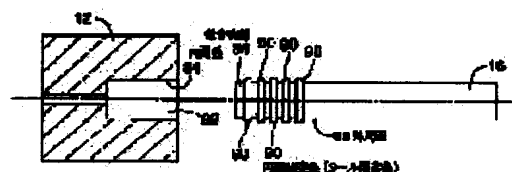
(54) INERTIAL PRESS-IN METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an inertial press-in method having a high sealing property at a gap between a fitting projected part and a fitting recessed part which are given inertial press-in.

SOLUTION: A plurality of peripherally continuous ring ribs 90 are formed in spaced intervals in the fitting directions of a fitting recessed part 82 and a fitting projected part 86 on the peripheral surface of the fitting projected part 86 of a second member 16 inertially pressed in the fitting recessed part 82 of a first member 12. Inertial movement presses the fitting projected part

86 in the fitting recessed part 82. The ring ribs 90 are tightly fitted in the inner perimetral surface 84 of the fitting recessed part 82 to mutual deposition. A gap between the fitting recessed part 82 and the fitting projected part 86 is continuously sealed in the peripheral direction, resulting in yielding a high sealing property. Ribs extending in parallel with the fitting direction may be provided together with ribs for sealing. Meshed ribs instead of the ring ribs may be provided to allow to function as the ribs for sealing. Ring ribs may be provided on the inner perimetral surface of the fitting recessed part.



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CLAIMS

[Claim(s)]

[Claim 1] The kinetic energy of the sense which approaches mutually is given to at least one side of the part I material which has a fitting crevice, and the part II material which has the fitting projected part which fits into the fitting crevice. It is the inertia press fit approach which presses a fitting projected part fit in a fitting crevice by inertia movement of the member which gave the kinetic energy. Prepare the protruding line for seals which followed the hoop direction at least in one side of the inner skin of said fitting crevice, and the peripheral face of said fitting projected part, and it sets after fitting of a fitting crevice and a fitting projected part. The inertia press fit approach characterized by considering as the condition that the clearance between both is continuously closed in a hoop direction by tightness fitting to the other party peripheral surface of the protruding line for seals.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the improvement in the seal nature of the fitting section by which was pressed mutually [two members] fit by inertia movement of the member to which kinetic energy was given between two members, and tightness fitting was especially carried out about the technique of the inertia press fit which presses these 2 member fit mutually.

[0002]

[Description of the Prior Art] On the other hand, two members mutually pressed fit by the inertia press fit technique come out, a certain part I material has a fitting crevice, the part II material which is another side has the fitting projected part which fits into the fitting crevice, and a fitting projected part is pressed fit in a fitting crevice. The example is indicated by JP,9-66421,A. the part (the fitting section is called hereafter) of a fitting projected part and a fitting crevice by which each other was pressed fit and fitting was carried out -- the clearance between a fitting projected part and a fitting crevice -- liquid -- be closed densely -- it is desirable for seal nature to be high. It is because an inertia press fit technique can be used not only for association of the 1st and the part II material which does not need seal nature for the fitting section but for association of the 1st and the part II material which needs seal nature. However, by the conventional inertia press fit approach, although the peripheral face of a fitting projected part and the inner skin of a fitting crevice carried out field contact where fitting of both of each other is carried out when [with the simple cross-section configuration of a fitting projected part and a fitting crevice] circular, seal nature was low and there were the 1st combined by the inertia press fit technique and a problem to which the application of the part II material is limited. By the abrasion of the peripheral face of a fitting projected part, or the inner skin of a fitting crevice, dispersion of a dimension, dispersion (inclination) of the posture at the time of press fit, etc., the planar pressure of the field by which fitting is carried out mutually becomes an ununiformity, the part which is not fully stuck arises and seal nature falls. Moreover, except the *****, when an parallel protruding line is formed in the direction of fitting at one side of a fitting projected part and a fitting crevice, although a protruding line eats into the other party peripheral surface, since it is easy to produce a clearance, it becomes much more inadequate [seal nature].

[0003]

[Object of the Invention, a technical-problem solution means, an operation, and effectiveness] This invention makes the above situation a background, it succeeds as a technical problem in the seal nature of the fitting section of the 1st and the part II material pressed fit mutually offering the high inertia press fit approach, and the inertia press fit approach of following each mode is acquired by this invention. Like a claim, each mode is classified into a term, gives a number to each item, and indicates it in the format of quoting the number of other terms if needed. This is for making easy an understanding of the typical thing of technical features given in this specification, and those combination, and technical features and those combination given in this specification should not be interpreted as being limited at the following.

(1) Give the kinetic energy of the sense which approaches mutually to at least one side of the part I material which has a fitting crevice, and the part II material which has the fitting projected part which fits into the fitting crevice. It is the inertia press fit approach which presses a fitting projected part fit in a fitting crevice by inertia movement of the member which gave the kinetic energy. Prepare the protruding line for seals which followed the hoop direction at least in one side of the inner skin of said fitting crevice, and the peripheral face of said fitting projected part, and it sets after fitting of a fitting crevice and a fitting projected part. The inertia press fit approach made into the condition that the clearance between both is continuously closed in a hoop direction by tightness fitting to the other party peripheral surface of the protruding line for seals. Although the vocabulary which "periphery" Comes to hit expressing the field inside a fitting crevice, the field of the outside of a fitting projected part, and the direction of the protruding line for seals, respectively is used, the cross-section configuration of a fitting crevice and a fitting projected part cannot be restricted circularly, but can adopt various configurations, such as other configurations, for example, a polygon etc. A through hole is sufficient as a fitting crevice, and a dead-end hole is sufficient as it. The protruding line for seals was continuously prepared in the hoop direction, and is closed in the hoop direction, and the clearance between the fitting crevices and fitting projected parts by which fitting is carried out is continuously closed in a hoop direction by the protruding line for seals. Even if the dimensional accuracy of the peripheral face of a fitting projected part and the inner skin of a fitting crevice is bad or an inclination is in the posture at the time of press fit, the protruding line for seals is projected and prepared at least from one side of these inner skin and a peripheral face, and since it is easy to deform, it can close and fit into the other party peripheral surface and fitness. And in order that the protruding line for seals may contact the peripheral surface of a fitting crevice in the condition near line contact, it becomes as compared with the case where a fitting projected part and a fitting crevice carry out field contact, seal nature is high, and possible to combine the 1st which needs seal nature, and the part II material with an inertia press fit technique. Moreover, by being easy to transform a protruding line, bundle cost tolerance of tightness fitting can be enlarged and processing cost can be reduced.

(2) Make circular the cross-section configuration of said fitting crevice and said fitting projected part. The inertia press fit approach given in (1) term. There is an advantage it becomes less indispensable [an advantage] it to also become easy to make process tolerance high while it becomes easy circularly then about the cross-section configuration of a fitting crevice and a fitting projected part to process it, and to double the relative topology of the part I material and the part II material at the time of press fit.

(3) form said protruding line for seals in the inner skin of the section near the opening of said fitting crevice at least (1) term -- or -- The inertia press fit approach given in (2) terms. In the section near the opening of a fitting crevice, the seal of a fitting projected part and the fitting crevice will be carried out at least, invasion of liquids, such as water, in the clearance between a fitting crevice and a fitting projected part will be prevented at the opening side of the fitting crevice which is invasion opening of a liquid, and invasion of the liquid of the great portion of fitting section will be prevented.

(4) form said protruding line for seals in the peripheral face of the section near the end face of said fitting projected part at least (1) term -- or -- The inertia press fit approach given in (2) terms. Above When the same effectiveness is acquired also in (3) terms, as compared with forming the protruding line for seals, formation also has an easy advantage in the section near the opening of a fitting crevice.

(5) Open said protruding line for seals in one side of the inner skin of said fitting crevice, and the peripheral face of a fitting projected part, open spacing in the direction of fitting of a fitting crevice and a fitting projected part, and form more than one. (1) thru/or the inertia press fit approach of any one publication of the (4) terms. Two or more protruding lines for seals carry out the seal of the clearance between a fitting projected part and a fitting crevice, respectively, and its seal nature improves more. The whole part of a fitting projected part and a fitting crevice by which fitting is carried out may be distributed, and two or more protruding lines for seals may be prepared, and may be prepared in the both ends of the part by which fitting is carried out, respectively. A fitting projected part is supported in two or more places which two or more protruding lines for seals left in the direction of fitting, and the inclination to the axis of a fitting projected part is prevented. Moreover, if this mode is adopted when a

fitting crevice is a through hole, invasion of the liquid to the fitting section from opening of the both sides of a through hole can be prevented. Or a fitting projected part and a fitting crevice may make the protruding line for seals approach mutually, and may prepare it so that a seal may be intensively carried out [near the opening of a fitting crevice] by two or more protruding lines for seals. If it does in this way, invasion of a liquid at back of the fitting section of a fitting projected part and a fitting crevice will be prevented much more certainly. When a fitting crevice is a dead-end hole, also when it is a through hole, of course, this mode is effective.

(6) form said protruding line for seals in the direction of fitting of said fitting crevice and fitting projected part along a right-angled flat surface (1) -- or -- The inertia press fit approach of any one publication of the (5) terms. There is an advantage with easy formation of the protruding line for seals.

(7) form at least in one side of the inner skin of said fitting crevice, and the peripheral face of said fitting projected part at least one protruding line prolonged in parallel with the direction of fitting of a fitting crevice and a fitting projected part (1) -- or -- The inertia press fit approach of any one publication of the (6) terms. When a fitting projected part is pressed fit in a fitting crevice, the protruding line prolonged in parallel with the direction of fitting eats into the other party peripheral surface, and the fitting section and a fitting crevice are clenched in a hoop direction. Thereby, if the 1st and the part II material are members which transmit torque to another side from one side, the improvement effectiveness of the transfer capacity of torsion torque will be acquired. Moreover, if the protruding line prolonged in parallel with the direction of fitting is previously prepared in the location by which fitting is carried out to the other party peripheral surface rather than fitting of the protruding line for seals is carried out to the other party peripheral surface, in case fitting of the protruding line for seals will be carried out, the fitting projected part and the fitting crevice are correctly positioned by the protruding line for seals, and are certainly pressed fit with the posture by which the protruding line for seals was stabilized.

(8) (1) as which the protruding line which makes the shape of a network continuously mutually is formed in the boundary of these crevices, and the reticulated protruding line is operated as said protruding line for seals by distributing one side of the inner skin of said fitting crevice, and the peripheral face of said fitting projected part two-dimensional, and forming many crevices in it -- or -- The inertia press fit approach of any one publication of the (4) terms. In a hoop direction, continuously, it has closed in the hoop direction, the clearance between a fitting crevice and a fitting projected part is continuously taken up in a hoop direction, and seal nature of the protruding line which makes the shape of a network improves.

[0004]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained to a detail based on a drawing. The suitable inertia press fit equipment for operation of the inertia press fit approach which is 1 operation gestalt of this invention is shown in drawing 1 . The 1st supporting structure 14 to which this inertia press fit equipment holds that it is fixed and horizontally the base 10 and the part I material 12 as a pressed fit member, It has the 2nd supporting structure 18 which holds that approach is possible and horizontally the part II material 16 as a press fit member to the part I material 12 currently held by the 1st supporting structure 14, and the movement control unit 20 which controls movement of the part II material 16 currently held by the 2nd supporting structure 18. These 1st supporting structure 14, the 2nd supporting structure 18, and the movement control device 20 are formed in the base 10 by each. The movement control unit 20 includes the accelerator 22 and the real inertia movement implementation device 24.

[0005] The 1st supporting structure 14 is equipped with the frame 30. The frame 30 is being fixed to said base 10. The hole 32 which extends horizontally is formed in the frame 30. The cylinder member 34 as an attachment component is formed in the hole 32 removable. The pin 36 of the pair as attachment-and-detachment control-section material is formed in the direction of a path removable at the cylinder member 34 and frame 30. The pin 36 of these pairs prevents that the cylinder member 34 secedes from a frame 30, when made to insert in the cylinder member 34 and a frame 30 in the direction of a path by coincidence. Wearing to the 1st supporting structure 14 of the part I material 12 is performed as follows. First, the pin 36 of a pair is removed from the 1st supporting structure 14, and the cylinder member 34 is

removed from a frame 30. Next, the part I material 12 is fixed to the cylinder member 34, and a frame 30 is equipped with both.

[0006] The 2nd supporting structure 18 is also equipped with the frame 40. This frame 40 is also being fixed to said base 10. While extending in same axle with the part II material 12 held by the 1st supporting structure 14, the maintenance hole 42 of the owner bottom which carries out opening to the 1st supporting structure 14 side is formed in the frame 40. The maintenance hole 42 holds the part II material 16 possible [approach to the part II material 12 currently held by the 1st supporting structure 14] by fitting in the part II material 16 possible [an airtight and sliding] substantially. Let the pars basilaris ossis occipitalis of the maintenance hole 42 be the stopper section 44. The stopper section 44 positions the part II material 16 in the location of the normal in the maintenance hole 42, as a drawing destructive line shows.

[0007] The air passage 50 is formed in the frame 40. This air passage 50 is connected to the air tank 54 which always accumulates air in the bottom of pressurization in the port 52. In the middle of the air passage 50, the needle valve 56 as a control valve is formed. This needle valve 56 has the valve 58 fitting of the sliding of was made possible to the frame 40, like illustration, intercepts an air passage 50 and switches to the cut off state which prevents that the air (pressurization air) from an air tank 54 flows in the maintenance hole 42, and the open condition of permitting opening an air passage 50 and the air from an air tank 54 flowing in the maintenance hole 42. This change is performed by the cam 60 driven with the driving gear which is not illustrated. If a needle valve 56 is switched to an open condition, air will flow in the maintenance hole 42, the pressure of part II material 16 back will become higher than atmospheric pressure, and the kinetic energy of the sense which approaches the part II material 16 at the part I material 12 will be given.

[0008] The 2nd supporting structure 18 is equipped with the conduit 62 as interior material of a proposal. An end is fixed to a frame 40, and the conduit 62 is arranged so that the wide-diameter hole 64 of the part I material 12 where the other end is held at the 1st supporting structure 14 may be reached. A conduit 62 specifies the movement path of the part II material 16 by fitting in possible [an airtight and sliding] substantially with the part II material 16. That is, in this operation gestalt, the guidance path of the part II material 16 is formed of in cooperation with the maintenance hole 42 and the conduit 62. The slot 66 which extends in shaft orientations is formed in the periphery of the part which carries out fitting to the part I material 12 of a conduit 62, and the flueway is constituted. When fitting of the fitting projected part which the part II material 16 mentions later is carried out to the fitting crevice which the part I material 12 mentions later, the air room demarcated by these fitting crevice and the fitting projected part is always made open for free passage to atmospheric air by the slot 66, and a front pressure is mostly maintained by atmospheric pressure in the direction of fitting of a fitting projected part.

[0009] The free passage hole 68 which makes atmospheric air open for free passage the air room formed behind the part II material 16 in the maintenance hole 42 just before the part II material 16 contacted a frame 40 further at the part I material 12 is formed. Therefore, just before the part II material 16 contacts the part I material 12, the pressure of the air room of part II material 16 back becomes almost equal to atmospheric pressure, and the part II material 16 will be in the condition of performing substantial inertia movement. That is, an air passage 50, an air tank 54, a needle valve 56, and cam 60 grade constitute said accelerator 22, the part which forms the free passage hole 68 among frames 40 constitutes said real inertia movement implementation device 24, and these accelerators 22 and the real inertia movement implementation device 24 constitute said movement control unit 20 of each other jointly.

[0010] The part I material 12 is a torsion bar spring used in the power-steering equipment of a car, and the part II material 16 is a shaft pressed fit in the torsion bar spring and balking impossible, and relative rotation impossible in the power-steering equipment. While the part I material 12 constitutes the shape of a cylinder with a stage generally, the fitting crevice 82 of a circular cross section is established in the end section. The diameter of the inner skin 84 of the fitting crevice 82 is a uniform straight cylinder side in shaft orientations.

[0011] The part II material 16 has the configuration prolonged along with one axis in a circular cross section, and the fitting projected part 86 of the circular cross section which fits into said fitting crevice 82 at the end section of that is formed. The part I material 12 and the part II material 16 are notionally shown in drawing 2. As shown in drawing 2, two or more protruding line slack protruding lines 90 for seals in a circle open spacing in the direction of fitting of the fitting crevice 82 and the fitting projected part 86, and are formed in the peripheral face 88 of the fitting projected part 86 of the part II material 16. [two or more] Two or more protruding lines 90 in a circle are formed in the direction of fitting of the fitting crevice 82 and the fitting projected part 86 along the right-angled flat surface, respectively, and the cross-section configuration was continued and prepared in nothing and a hoop direction, and has closed the shape of a perfect circle in the hoop direction. Moreover, the dimension before press fit of each outer diameter of two or more protruding lines 90 in a circle is all the same, and is made larger than the dimension before press fit of the diameter of the inner skin 84 of the fitting crevice 82.

[0012] In advance of the press fit to the part I material 12 of the part II material 16, the 1st supporting structure 14 is equipped with the part I material 12, and the part II material 16 is held by the 2nd supporting structure 18. Fitting of the part II material 16 is carried out into the maintenance hole 42, and it is positioned by the stopper section 44. And a needle valve 56 is opened, air is supplied to the space in the maintenance hole 42 from an air tank 54, and the back pressure of the part II material 16 is made into high pressure from atmospheric pressure. Thereby, the part II material 16 is accelerated in the direction parallel to an own axis, and kinetic energy is given to the part II material 16. Consequently, the part II material 16 approaches the part I material 12, the part II material 16 contacts the part I material 12 soon, and the press fit to the fitting crevice 82 of the part I material 12 of the fitting projected part 86 of the part II material 16 is started.

[0013] The kinetic energy of the sense close to the part I material 12 is given to the part II material 16, and the fitting projected part 86 is pressed fit in the fitting crevice 82 by inertia movement. While the protruding line 90 in a circle closes and fits into the inner skin 84 of the fitting crevice 82, joining of both of each other is carried out by frictional heat. The dimension before each press fit of the outer diameter of the protruding line 90 in a circle and the bore of the inner skin 84 of the fitting crevice 82 is set up so that joining of the protruding line 90 in a circle may be carried out to the fitting crevice 82. While the 1st and the part II material 12 and 16 are combined firmly by that cause, in after fitting of the fitting crevice 82 and the fitting projected part 86, the clearance between the fitting crevice 82 and the fitting projected part 86 is continuously taken up in a hoop direction, and high seal nature is obtained. In addition, it is closed, and the protruding line 90 in a circle and the inner skin 84 of the fitting crevice 82 should just fit in, and welding is not indispensable.

[0014] Another operation gestalt of this invention is shown in drawing 3. In this operation gestalt, the fitting crevice 102 established in the part I material 100 constitutes the ** with a stage of an owner bottom, and let the major-diameter crevice 104 and pars-basilaris-ossis-occipitalis side be the minor diameter crevice 106 of a minor diameter for the opening side from the major-diameter crevice 104. In the peripheral face 114 of the fitting projected part 112 of the part II material 110, serration is formed in the part by the side of the tip (part of the side by which fitting is previously carried out to the fitting crevice 102), and the protruding line 116 to which the part of two or more crests (**) of serration extends in parallel with the direction of fitting of the fitting crevice 102 and the fitting projected part 112, respectively is constituted. The protruding line 116 of these plurality is formed in the equiangular distance. Moreover, two or more (it sets in this operation gestalt and they are two pieces) said protruding lines 90 in a circle and same protruding line slack protruding lines 118 for seals in a circle are formed in the part which adjoins the protruding line 116 of the peripheral face 114 of the fitting projected part 112 at the end face side (side by which fitting is carried out to the fitting crevice 102 and the back) of the fitting projected part 112. The distance from the axis of the fitting projected part 112 of the external surface of a protruding line 116 is smaller than the radius of the inner skin 122 of the major-diameter crevice 104, it is made larger than the radius of the inner skin 120 of the minor diameter crevice 106, and the outer diameter of the protruding line 118 in a circle is made larger than the diameter of the inner skin 122 of the major-diameter crevice 104. In addition, each of these dimensions is dimensions before

press fit.

[0015] The part II material 110 is made to approach the part I material 100 like said part II material 12 by the air supplied from an air tank, and fitting of the fitting projected part 112 is carried out to the fitting crevice 102 by inertia movement. First, although fitting of the part in which the protruding line 116 of the fitting projected part 112 was formed is carried out to the fitting crevice 102, while a protruding line 116 passes without eating into the inner skin 122 of the major-diameter crevice 104 and eats into the inner skin 120 of the minor diameter crevice 106, joining of it is mutually carried out by frictional heat. Moreover, while it becomes tight with the inner skin 122 of the major-diameter crevice 104 and they fit in, joining of them is mutually carried out by frictional heat. Two projected parts 118 in a circle are not recriminated with a protruding line 116, but it is pressed fit in the inner skin 122 of the major-diameter crevice 104 which is not damaged, and the 1st and the part II material 100,110 are combined certainly. In addition, in this operation gestalt, since the torque-transmission capacity between the part I material 100 and the part II material 110 is secured with interlocking to the inner skin 120 of the minor diameter crevice 106 of a protruding line 116, the need for the protruding line 118 in a circle welding with the inner skin 122 of the major-diameter crevice 104 is low as compared with said operation gestalt.

[0016] Still more nearly another operation gestalt of this invention is shown in drawing 4. In this operation gestalt, the part I material is constituted like the operation gestalt shown in drawing 1 and drawing 2, and attaches and shows the same sign. Many crevices 136 are distributed two-dimensional by the peripheral face 134 of the fitting projected part 132 of the part II material 130, and are formed in it, and, thereby, the reticulated protruding line 138 which makes the shape of a network continuously mutually is formed in the boundary of these crevices 136. In the hoop direction of the fitting projected part 132, continuously, the reticulated protruding line 138 is closed and functions as a protruding line for seals. The dimension before press fit of the diameter (distance from the axis of the fitting projected part 132 of the part located in a flat surface right-angled in the direction of fitting of the fitting projected part 132 of the reticulated protruding line 138) of the external surface of this reticulated protruding line 138 is made larger than the dimension before press fit of the diameter of the inner skin 84 of the fitting crevice 82.

[0017] When the fitting projected part 132 is pressed fit in the fitting crevice 82, while it is closed by the reticulated protruding line 138 with the inner skin 84 of the fitting crevice 82 and it fits in, by the frictional heat of the reticulated protruding line 138 and the fitting crevice 82, joining of both of each other is carried out, and the 1st and the part II material 12,130 are combined firmly. Moreover, the clearance between the fitting projected part 132 and the fitting crevice 82 is continuously taken up in a hoop direction.

[0018] In addition, in each above-mentioned operation gestalt, although the protruding line 90,118 in a circle and the reticulated protruding line 138 were formed in the part II material 16,110,130, they may be prepared in the part I material which has a fitting crevice. For example, two or more protruding line slack protruding lines 146 for seals in a circle are formed in the inner skin 144 whole of the fitting crevice 142 of the part I material 140 shown in drawing 5. These protruding lines 146 in a circle are formed in the direction of fitting of the fitting crevice 142 and the fitting projected part 150 of the part II material 148 along the right-angled flat surface, the cross-section configuration constituted the shape of a perfect circle, and has closed them continuously in the hoop direction, and they open spacing in the direction of fitting of the fitting projected part 150 and the fitting crevice 142, and are formed in it. The dimension before press fit of the fitting projected part 150 of each bore of the protruding line 146 of these plurality in a circle is all the same, and is made smaller than the dimension before press fit of the diameter of the fitting projected part 150.

[0019] At the time of the press fit to the fitting crevice 142 of the fitting projected part 150, while it is closed by the protruding line 146 in a circle with the fitting projected part 150 and it fits in, joining is mutually carried out by both frictional heat, and while the 1st and the part II material 140,148 are combined firmly, the clearance between the fitting projected part 150 and the fitting crevice 142 is continuously taken up in a hoop direction.

[0020] In the operation gestalt shown in drawing 1 and drawing 2, one protruding line in a circle is good to even prepare. For example, as shown in drawing 6, it is the location a little distant from the tip (edge by which fitting is previously carried out to the fitting crevice of the part I material) of the fitting projected part 162 of the part II material 160, and one protruding line 164 in a circle is formed in the end face section of the fitting projected part 162. Moreover, the path of opening makes the fitting crevice 168 of the part I material 166 a larger ** with a stage than a pars basilaris ossis occipitalis. The diameter of the point in which the protruding line 164 of the peripheral face 170 of the fitting projected part 162 in a circle is not formed is smaller than the diameter of the inner skin 174 of the major-diameter crevice 172 of the fitting crevice 168, and is made larger than the diameter of the inner skin 178 of the minor diameter crevice 176. Moreover, the outer diameter of the protruding line 164 in a circle is made larger than the diameter of the inner skin 174 of the major-diameter crevice 172. Each of these dimensions is dimensions before press fit.

[0021] At the time of the press fit to the fitting crevice 168 of the fitting projected part 162, the point in which the projected part 164 of the fitting projected part 162 in a circle is not formed is first pressed fit in the minor diameter crevice 176, and, thereby, the inclination to the axis of the part II material 160 is prevented. Subsequently, it succeeds in a seal by pressing the protruding line 164 in a circle fit in the major-diameter crevice 172. It passes without eating into the inner skin 174 of the major-diameter crevice 172, and the point of the fitting projected part 162 is pressed fit in the minor diameter crevice 176. While the protruding line 164 in a circle does not recriminate with the point of the fitting projected part 162, but eating into the inner skin 174 of the major-diameter crevice 172 which is not damaged and closing and fitting in, with frictional heat, joining is carried out mutually and it succeeds in a seal good. Instead of using opening of a fitting crevice as a major diameter, an opening side is good also as taper opening which a diameter increases gradually.

[0022] In addition, in the operation gestalt shown in drawing 1 and drawing 2, although the diameter before press fit of a fitting projected part of the inner skin of a fitting crevice was made into homogeneity in shaft orientations, it is good also as taper inner skin of the minute taper value which becomes so small that the diameter before press fit keeps away from opening about the inner skin of a fitting crevice. For example, a protruding line in a circle is prepared in two places of the section near the tip, and the location distant from the tip, and each outer diameter of these protruding lines in a circle presupposes at a fitting projected part that it is the same. At the time of the press fit to the fitting crevice of a fitting projected part, when the protruding line in a circle prepared in the location which fitting was carried out while the protruding line in a circle by the side of the tip of a fitting projected part rubbed in the inner skin and perimeter from the part by the side of opening of the inner skin of a fitting crevice, and is distant from the tip of a fitting projected part is close to termination of press fit, fitting of it is carried out to a fitting crevice, and it rubs in the inner skin and the perimeter of a fitting crevice. Although the direction of the protruding line in a circle by the side of a tip has much abrasion loss with the inner skin of a fitting crevice depended for rubbing, by therefore, the thing for which inner skin of a fitting crevice is made into the above taper inner skin It becomes tight with the part near the fitting limit location (fitting edge of a side far from opening into which a fitting projected part advances) of a fitting crevice, and it fits in. The protruding line of another side in a circle It is closed with the inner skin by the side of opening of a fitting crevice, fits in, and is pressed fit by the same bundle cost, and joining can be carried out in the same condition. Moreover, although the dimension before press fit of each outer diameter of two or more protruding lines 90 in a circle was all made the same, it may be changed mutually. For example, while preparing a protruding line in a circle in two places of the section near the tip of a fitting projected part, and the location distant from the tip, respectively, the outer diameter of the protruding line in a circle by the side of a tip is made larger than another side. In addition, the diameter before press fit of the inner skin of a fitting crevice is made into homogeneity in shaft orientations. the protruding line in a circle which the protruding line in a circle by the side of the tip of a fitting projected part separated from the tip, and was prepared when a fitting projected part was pressed fit in a fitting crevice -- the inner skin of a fitting crevice -- grind -- although there is much **** and abrasion loss is large, by enlarging the outer diameter, two protruding lines in a circle are mostly pressed fit in a fitting

crevice by homogeneity-less cost, and joining can be carried out in the same condition. In these cases, in three or more pieces and shaft orientations, all may separate spacing and may prepare a protruding line in a circle. If the diameter of the inner skin of a fitting crevice is made into homogeneity in shaft orientations, as for the outer diameter of a protruding line in a circle, it is desirable to make it the protruding line more in a circle by the side of the tip of a fitting projected part become large. Moreover, while making inner skin of a fitting crevice into the taper inner skin to which a diameter becomes small so that it separates from opening, the protruding line more in a circle by the side of the tip of a fitting projected part may make small the outer diameter of two or more protruding lines in a circle. In this case, while two or more protruding lines in a circle are pressed fit in a fitting crevice by the respectively same bundle cost, it is desirable to set up the outer-diameter dimension of a protruding line in a circle and the inside diameter of a fitting crevice so that joining may be carried out in the same condition. At the time of the press fit to the fitting crevice of a fitting projected part, the protruding line in a circle by the side of the tip of a fitting projected part Fitting is carried out without rubbing in the inner skin and the perimeter of a fitting crevice until it results near the fitting limit location of a fitting crevice. In inner skin and the perimeter, it rubs [near the fitting limit location of a fitting crevice], and it is pressed fit, wearing out. The protruding line of a side far from the tip of a fitting projected part in a circle It is pressed fit rubbing against the inner skin of a fitting crevice, when close to termination of press fit, and the thing with two or more almost same protruding lines in a circle which amount wear is carried out and is substantially pressed fit by the same bundle cost is desirable.

[0023] Furthermore, in the operation gestalt shown in drawing 3 , one protruding line for seals is good to even prepare. Moreover, in the operation gestalt shown in drawing 4 , as well as [the situation is almost the same as the case where a protruding line in a circle is prepared in a fitting projected part, and] the case where a protruding line in a circle is prepared when preparing a reticulated protruding line in the fitting projected part of the part II material and making it function on it as a protruding line for seals, various modes can be taken.

[0024] Moreover, it combines mutually and each description given in each above-mentioned operation gestalt can be carried out. For example, while preparing a reticulated protruding line in the operation gestalt shown in drawing 4 , the protruding line prolonged in parallel may be prepared in the direction of fitting from it at a tip side. Moreover, when preparing the protruding line for seals in the inner skin of a fitting crevice, the protruding line for seals by the side of opening may make a bore small, or a tip side may make the diameter of a fitting projected part small.

[0025] In addition, this invention can be carried out in the mode which performed various deformation and amelioration based on this contractor's knowledge, without deviating from a claim.

[Translation done.]

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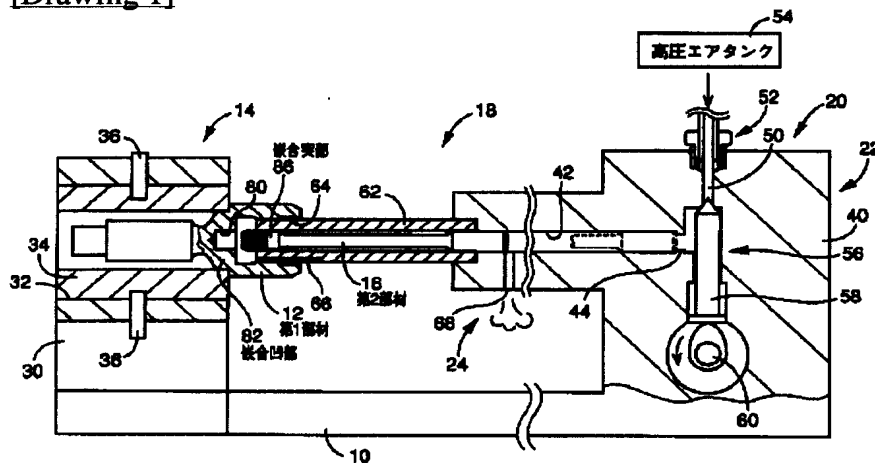
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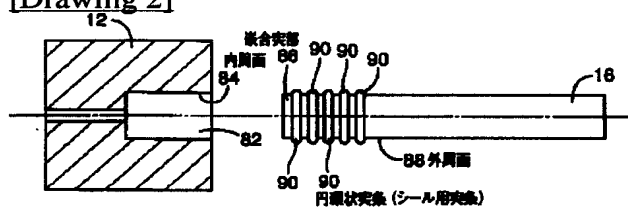
3.In the drawings, any words are not translated.

DRAWINGS

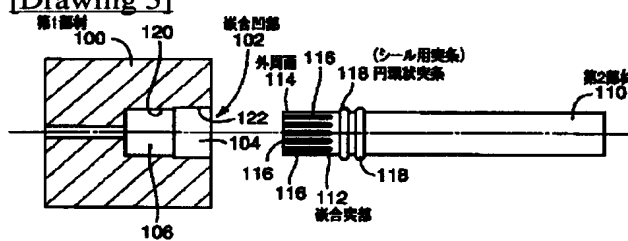
[Drawing 1]



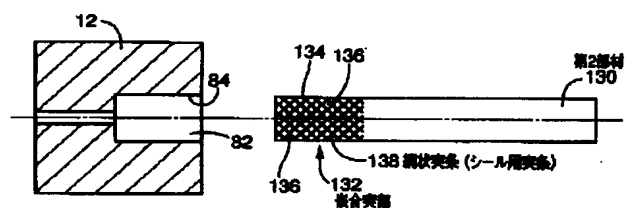
[Drawing 2]



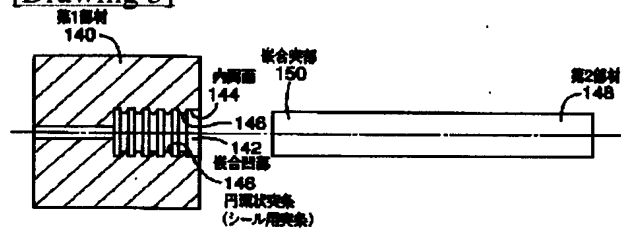
[Drawing 3]



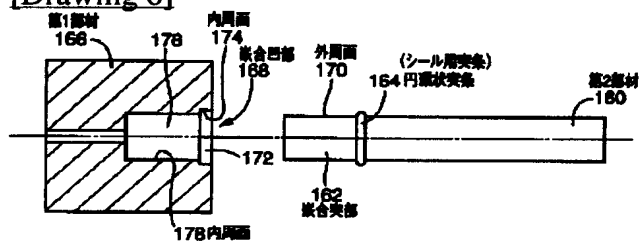
[Drawing 4]



[Drawing 5]



[Drawing 6]



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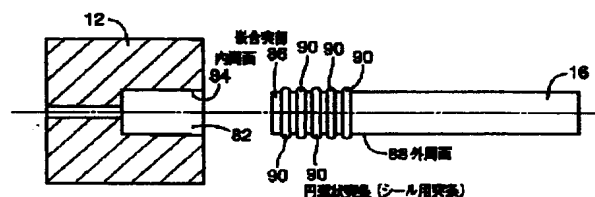
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(54) 【発明の名称】 慣性圧入方法

(57) 【要約】

【課題】 慣性圧入される嵌合突部と嵌合凹部との隙間のシール性が高い慣性圧入方法を提供する。

【解決手段】 第1部材12の嵌合凹部82に圧入される第2部材16の嵌合突部86の外周面に、周方向に連続した円環状突条90を、嵌合凹部82と嵌合突部86との嵌合方向に間隔をあけて複数個形成する。嵌合突部86を慣性運動により嵌合凹部82に圧入し、円環状突条90が嵌合凹部82の内周面84にしまり嵌合するとともに互いに溶着し、嵌合凹部82と嵌合突部86との隙間が周方向において連続して塞がれ、高いシール性が得られる。シール用突条と共に、嵌合方向に平行に延びる突条を設けてもよく、円環状突条に代えて網状突条を設けてシール用突条として機能させてもよく、嵌合凹部の内周面に円環状突条を設けてもよい。



【特許請求の範囲】

【請求項 1】 嵌合凹部を有する第 1 部材とその嵌合凹部に嵌合する嵌合突部を有する第 2 部材との少なくとも一方に相互に接近する向きの運動エネルギーを付与し、その運動エネルギーを付与した部材の慣性運動により嵌合突部を嵌合凹部に圧入する慣性圧入方法であって、前記嵌合凹部の内周面と前記嵌合突部の外周面との少なくとも一方に、周方向に連続したシール用突条を設け、嵌合凹部と嵌合突部との嵌合後において、両者の隙間がシール用突条の相手側周面へのしまり嵌合により周方向において連続して塞がれる状態とすることを特徴とする慣性圧入方法。

【発明の詳細な説明】**【0001】**

【発明の属する技術分野】 本発明は、2つの部材のうち、運動エネルギーを付与された部材の慣性運動により、それら 2 部材を相互に圧入する慣性圧入の技術に関するものであり、特に、2 部材の互いに圧入され、しまり嵌合された嵌合部のシール性の向上に関するものである。

【0002】

【従来の技術】 慣性圧入技術により相互に圧入される 2 部材の一方である第 1 部材は嵌合凹部を有し、他方である第 2 部材はその嵌合凹部に嵌合する嵌合突部を有し、嵌合突部が嵌合凹部に圧入される。特開平 9-66421 号公報にその一例が記載されている。嵌合突部と嵌合凹部との互いに圧入され、嵌合された部分（以下、嵌合部と称する）は、嵌合突部と嵌合凹部との隙間が液密に塞がれ、シール性が高いことが望ましい。嵌合部にシール性を必要としない第 1、第 2 部材の結合のみならず、シール性を必要とする第 1、第 2 部材の結合にも、慣性圧入技術を利用することができるからである。しかしながら、従来の慣性圧入方法では、嵌合突部と嵌合凹部との断面形状が単純な円形である場合には、両者が互いに嵌合された状態で、嵌合突部の外周面と嵌合凹部の内周面とが面接触するのであるが、シール性が低く、慣性圧入技術により結合される第 1、第 2 部材の用途が限定される問題があった。嵌合突部の外周面や嵌合凹部の内周面の摺り傷や、寸法のばらつきや、圧入時の姿勢のばらつき（傾き）等により、互いに嵌合される面の面圧が不均一になって十分に密着しない部分が生じ、シール性が低下するのである。また、嵌合突部と嵌合凹部との一方に嵌合方向に平行な突条が形成される場合には、突条は相手側周面に食い込むが、その食い込み部以外では隙間が生じ易いため、一層シール性が不十分となる。

【0003】

【発明が解決しようとする課題、課題解決手段、作用および効果】 本発明は、以上の事情を背景とし、互いに圧入される第 1、第 2 部材の嵌合部のシール性が高い慣性圧入方法を提供することを課題として為されたものであり、本発明によって、下記各態様の慣性圧入方法が得ら

れる。各態様は請求項と同様に、項に区分し、各項に番号を付し、必要に応じて他の項の番号を引用する形式で記載する。これは、本明細書に記載の技術的特徴とそれらの組合わせの代表的なものの理解を容易にするためであり、本明細書に記載の技術的特徴およびそれらの組合わせが以下のものに限定されると解釈されるべきではない。

（1）嵌合凹部を有する第 1 部材とその嵌合凹部に嵌合する嵌合突部を有する第 2 部材との少なくとも一方に相互に接近する向きの運動エネルギーを付与し、その運動エネルギーを付与した部材の慣性運動により嵌合突部を嵌合凹部に圧入する慣性圧入方法であって、前記嵌合凹部の内周面と前記嵌合突部の外周面との少なくとも一方に、周方向に連続したシール用突条を設け、嵌合凹部と嵌合突部との嵌合後において、両者の隙間がシール用突条の相手側周面へのしまり嵌合により周方向において連続して塞がれる状態とする慣性圧入方法。嵌合凹部の内側の面、嵌合突部の外側の面およびシール用突条の方向をそれぞれ表すにあたり、「周」なる用語を用いるが、嵌合凹部および嵌合突部の横断面形状は円形に限らず、その他の形状、例えば、多角形等、種々の形状が採用可能である。嵌合凹部は、貫通穴でもよく、行き止まり穴でもよい。シール用突条は周方向において連続して設けられて周方向において閉じており、互いに嵌合される嵌合凹部と嵌合突部との隙間がシール用突条により、周方向において連続して塞がれる。嵌合突部の外周面および嵌合凹部の内周面の寸法精度が悪かったり、圧入時の姿勢に傾きがあっても、シール用突条はそれら内周面と外周面との少なくとも一方から突出して設けられており、変形し易いため、相手側周面と良好にしまり嵌合することができる。しかも、シール用突条が嵌合凹部の周面に線接触に近い状態で接触するため、嵌合突部と嵌合凹部とが面接触する場合に比較してシール性が高く、シール性を必要とする第 1、第 2 部材を慣性圧入技術によって結合することが可能となる。また、突条が変形し易いことによって、しまり嵌合のしめ代公差を大きくすることができ、加工コストを低減させることができる。

（2）前記嵌合凹部と前記嵌合突部との横断面形状を円形とする（1）項に記載の慣性圧入方法。嵌合凹部と嵌合突部との横断面形状を円形とすれば、加工が容易となるとともに加工精度を高くすることも容易となり、また、圧入時に第 1 部材と第 2 部材との相対位相を合わせることが不可欠ではなくなる利点がある。

（3）前記シール用突条を、少なくとも、前記嵌合凹部の開口近傍部の内周面に形成する（1）項または（2）項に記載の慣性圧入方法。嵌合突部と嵌合凹部とが、少なくとも、嵌合凹部の開口近傍部においてシールされ、嵌合凹部と嵌合突部との隙間への水等の液体の侵入が、液体の侵入口である嵌合凹部の開口側において防止され、嵌合部の大半への液体の侵入が防止されることとなる。

(4) 前記シール用突条を、少なくとも、前記嵌合突部の基端近傍部の外周面に形成する(1)項または(2)項に記載の慣性圧入方法。上記(3)項におけると同様な効果が得られる上、嵌合凹部の開口近傍部にシール用突条を形成するのに比較して形成が容易である利点もある。

(5) 前記シール用突条を、前記嵌合凹部の内周面と嵌合突部の外周面との一方に、嵌合凹部と嵌合突部との嵌合方向に間隔をあけて複数個形成する(1)ないし(4)項のいずれか1つに記載の慣性圧入方法。複数個のシール用突条はそれぞれ、嵌合突部と嵌合凹部との隙間をシールし、シール性がより向上する。複数個のシール用突条は、嵌合突部と嵌合凹部との互いに嵌合される部分全体に分散させて設けてもよく、互いに嵌合される部分の両端部にそれぞれ設けてもよい。複数個のシール用突条が嵌合方向において離れた複数箇所において嵌合突部を支持し、嵌合突部の軸線に対する傾きが防止される。また、嵌合凹部が貫通穴である場合に本態様を採用すれば、貫通穴の両側の開口からの嵌合部への液体の侵入を防止することができる。あるいは、嵌合突部と嵌合凹部とが、嵌合凹部の開口近傍において複数個のシール用突条によって集中的にシールされるように、シール用突条を互いに近接させて設けてもよい。このようにすれば、嵌合突部と嵌合凹部との嵌合部の奥への液体の侵入が一層確実に防止される。嵌合凹部が行き止まり穴である場合は勿論、貫通穴である場合にも本態様は有効である。

(6) 前記シール用突条を、前記嵌合凹部と嵌合突部との嵌合方向に直角な平面に沿って形成する(1)ないし(5)項のいずれか1つに記載の慣性圧入方法。シール用突条の形成が容易である利点がある。

(7) 前記嵌合凹部の内周面と前記嵌合突部の外周面との少なくとも一方に、嵌合凹部と嵌合突部との嵌合方向に平行に延びる突条を少なくとも1つ形成する(1)ないし(6)項のいずれか1つに記載の慣性圧入方法。嵌合突部が嵌合凹部に圧入されるとき、嵌合方向に平行に延びる突条は相手側周面に食い込み、嵌合部と嵌合凹部とが周方向において噛み合わされる。それにより、第1、第2部材が一方から他方へトルクを伝達する部材であれば、ねじりトルクの伝達能力の向上効果が得られる。また、嵌合方向に平行に延びる突条が、シール用突条が相手側周面に嵌合されるよりも先に、相手側周面に嵌合される位置に設けられていれば、シール用突条が嵌合される際、嵌合突部と嵌合凹部とはシール用突条により正確に位置決めされており、シール用突条が安定した姿勢で確実に圧入される。

(8) 前記嵌合凹部の内周面と前記嵌合突部の外周面との一方に、多数の凹部を二次元的に分散させて形成することにより、それら凹部の境界に互いに連続して網状をなす突条を形成し、その網状の突条を前記シール用突条として機能させる(1)ないし(4)項のいずれか1つに記載の慣性圧入方法。網状をなす突条も周方向において連

続し、周方向において閉じており、嵌合凹部と嵌合突部との隙間が周方向において連続して塞がれ、シール性が向上する。

【0004】

【発明の実施の形態】以下、本発明の実施形態を図面に基いて詳細に説明する。図1には、本発明の一実施形態である慣性圧入方法の実施に好適な慣性圧入装置が示されている。この慣性圧入装置は、ベース10と、被圧入部材としての第1部材12を固定的にかつ水平に保持する第1保持装置14と、圧入部材としての第2部材16を、第1保持装置14によって保持されている第1部材12に接近可能にかつ水平に保持する第2保持装置18と、その第2保持装置18によって保持されている第2部材16の運動を制御する運動制御装置20とを備えている。それら第1保持装置14、第2保持装置18および運動制御装置20はいずれもベース10に設けられている。運動制御装置20は、加速装置22と実質慣性運動実現機構24とを含んでいる。

【0005】第1保持装置14は、フレーム30を備えている。フレーム30は前記ベース10に固定されている。フレーム30には、水平方向に延びる穴32が形成されている。その穴32に保持部材としての円筒部材34が着脱可能に設けられている。その円筒部材34とフレーム30とは着脱制御部材としての一对のピン36が径方向に着脱可能に設けられている。それら一对のピン36は円筒部材34とフレーム30とに径方向に同時に嵌入させられることによって円筒部材34がフレーム30から離脱することを阻止する。第1部材12の第1保持装置14への装着は次のようにして行われる。まず、一对のピン36を第1保持装置14から取り外し、円筒部材34をフレーム30から取り外す。次に、その円筒部材34に第1部材12を固定し、両者をフレーム30に装着する。

【0006】第2保持装置18も、フレーム40を備えている。このフレーム40も前記ベース10に固定されている。フレーム40には、第1保持装置14によって保持される第2部材12と同軸的に延びるとともに、第1保持装置14の側において開口する有底の保持穴42が形成されている。保持穴42は、第2部材16を実質的に気密かつ摺動可能に嵌合することにより、第2部材16を、第1保持装置14により保持されている第2部材12に接近可能に保持するものである。保持穴42の底部はストッパ部44とされている。ストッパ部44は、第2部材16を、図中破線で示すように、保持穴42内における正規の位置に位置決めするものである。

【0007】フレーム40にはエア通路50が形成されている。このエア通路50は、ポート52において、空気を常時加圧下に蓄積するエアタンク54に接続されている。エア通路50の途中には、制御弁としてのニードル弁56が設けられている。このニードル弁56は、フ

レーム40に摺動可能に嵌合された弁子58を有し、図示のように、エア通路50を遮断して、エアタンク54からのエア（加圧空気）が保持穴42内に流入することを阻止する遮断状態と、エア通路50を開いて、エアタンク54からのエアが保持穴42内に流入することを許容する開放状態とに切り換わる。この切換えは、図示しない駆動装置によって駆動されるカム60によって行われる。ニードル弁56が開放状態に切り換えられれば、保持穴42内にエアが流入し、第2部材16後方の圧力が大気圧より高くなり、第2部材16に第1部材12に接近する向きの運動エネルギーが付与される。

【0008】第2保持装置18は、案内部材としての導管62を備えている。導管62は、一端がフレーム40に固定され、他端は第1保持装置14に保持されている第1部材12の大径穴64に至るように配設されている。導管62は、第2部材16と実質的に気密かつ摺動可能に嵌合することにより、第2部材16の運動経路を規定する。すなわち、本実施形態においては、保持穴42と導管62との共同によって第2部材16の案内通路が形成されているのである。導管62の第1部材12と嵌合させられる部分の外周には、軸方向に延びる溝66が形成され、排気通路を構成している。第2部材16の後述する嵌合突部が第1部材12の後述する嵌合凹部に嵌合されるとき、それら嵌合凹部および嵌合突部により画定されるエア室は溝66により常に大気に連通させられ、嵌合突部の嵌合方向において前方の圧力がほぼ大気圧に維持される。

【0009】フレーム40にはさらに、第2部材16が第1部材12に当接する直前に、保持穴42内において第2部材16の後方に形成されたエア室を大気に連通させる連通孔68が形成されている。そのため、第2部材16が第1部材12に当接する直前に、第2部材16後方のエア室の圧力がほぼ大気圧と等しくなり、第2部材16は実質的な慣性運動を行う状態となる。すなわち、エア通路50、エアタンク54、ニードル弁56、カム60等が前記加速装置22を構成し、フレーム40のうち、連通孔68を形成する部分が前記実質慣性運動実現機構24を構成し、それら加速装置22と実質慣性運動実現機構24とが互いに共同して前記運動制御装置20を構成しているのである。

【0010】第1部材12は、車両のパワーステアリング装置において使用されるトーションバーであり、第2部材16は、そのパワーステアリング装置においてそのトーションバーと離脱不能かつ相対回転不能に圧入されるシャフトである。第1部材12は、概して段付きの円柱状を成すとともに、一端部に円形断面の嵌合凹部82が設けられている。嵌合凹部82の内周面84は、直径が軸方向において均一であるストレートな円筒面である。

【0011】第2部材16は円形断面で一軸線に沿って

延びる形状を有しており、その一端部に、前記嵌合凹部82に嵌合する円形断面の嵌合突部86が形成されている。第1部材12および第2部材16を図2に概念的に示す。図2に示すように、第2部材16の嵌合突部86の外周面88には、複数のシール用突条たる円環状突条90が、嵌合凹部82と嵌合突部86との嵌合方向に間隔をあけて複数個形成されている。複数の円環状突条90はそれぞれ、嵌合凹部82と嵌合突部86との嵌合方向に直角な平面に沿って形成されていて、断面形状が真円状をなし、周方向に連続して設けられ、周方向において閉じている。また、複数の円環状突条90の各外径の圧入前寸法は、全部同じであって、嵌合凹部82の内周面84の直径の圧入前寸法より大きくされている。

【0012】第2部材16の第1部材12への圧入に先立ち、第1部材12が第1保持装置14に装着され、第2部材16が第2保持装置18により保持される。保持穴42内に第2部材16が嵌合され、ストッパ部44により位置決めされるのである。そして、ニードル弁56が開かれ、エアタンク54からエアが保持穴42内の空間に供給されて、第2部材16の後方圧が大気圧より高圧にされる。それにより第2部材16は自身の軸線に平行な方向に加速され、第2部材16が運動エネルギーを付与される。その結果、第2部材16が第1部材12に接近し、やがて第2部材16が第1部材12と接触し、第2部材16の嵌合突部86の第1部材12の嵌合凹部82への圧入が開始される。

【0013】第2部材16は、第1部材12に接近する向きの運動エネルギーを付与され、慣性運動により嵌合突部86が嵌合凹部82に圧入される。円環状突条90が嵌合凹部82の内周面84にしまり嵌合するとともに、摩擦熱によって両者が互いに溶着される。円環状突条90の外径および嵌合凹部82の内周面84の内径の各圧入前の寸法が、円環状突条90が嵌合凹部82に溶着されるように設定されているのである。それにより第1、第2部材12、16が強固に結合されるとともに、嵌合凹部82と嵌合突部86との嵌合後において、嵌合凹部82と嵌合突部86との隙間が周方向において連続して塞がれ、高いシール性が得られる。なお、円環状突条90と嵌合凹部82の内周面84とはしまり嵌合すればよく、溶着することは不可欠ではない。

【0014】本発明の別の実施形態を図3に示す。本実施形態において、第1部材100に設けられた嵌合凹部102は有底の段付状を成し、開口側が大径凹部104、底部側が大径凹部104より小径の小径凹部106とされている。第2部材110の嵌合突部112の外周面114には、その先端側の部分（先に嵌合凹部102と嵌合される側の部分）にセレーションが形成されており、セレーションの複数の山（突）の部分がそれぞれ、嵌合凹部102と嵌合突部112との嵌合方向に平行に延びる突条116を構成している。これら複数の突条1

16は、等角度間隔に設けられている。また、嵌合突部112の外周面114の突条116に、嵌合突部112の基端側（嵌合凹部102と後に嵌合される側）において隣接する部分に、前記円環状突条90と同様のシール用突条たる円環状突条118が複数個（本実施形態においては2個）、設けられている。突条116の外面の嵌合突部112の軸線からの距離は、大径凹部104の内周面122の半径より小さく、小径凹部106の内周面120の半径より大きくされており、円環状突条118の外径は、大径凹部104の内周面122の直径より大きくされている。なお、これらの寸法は、いずれも圧入前の寸法である。

【0015】第2部材110は、前記第2部材12と同様に、エアタンクから供給されるエアによって第1部材100に接近させられ、慣性運動により嵌合突部112が嵌合凹部102に嵌合される。まず、嵌合突部112の突条116が設けられた部分が嵌合凹部102に嵌合されるが、突条116は、大径凹部104の内周面122には食い込むことなく通過し、小径凹部106の内周面120に食い込むとともに、摩擦熱によって互いに溶着される。また、2個の円環状突条118は大径凹部104の内周面122としまり嵌合するとともに、摩擦熱により互いに溶着される。2個の円環状突部118は、突条116と擦り合わず、荒らされていない大径凹部104の内周面122に圧入され、第1、第2部材100、110が確実に結合される。なお、本実施形態においては、第1部材100と第2部材110との間のトルク伝達能力は突条116の小径凹部106の内周面120への食い込みによって確保されるため、円環状突条118が大径凹部104の内周面122と溶着することの必要性は、前記実施形態に比較して低い。

【0016】本発明の更に別の実施形態を図4に示す。本実施形態において、第1部材は図1および図2に示す実施形態と同様に構成されており、同じ符号を付して示す。第2部材130の嵌合突部132の外周面134には、多数の凹部136が二次元的に分散させられて形成されており、それにより、それら凹部136の境界に互いに連続して網状をなす網状突条138が形成されている。網状突条138は、嵌合突部132の周方向において連続し、閉じており、シール用突条として機能する。この網状突条138の外面の直径（網状突条138の嵌合突部132の嵌合方向に直角な平面内に位置する部分の嵌合突部132の軸線からの距離）の圧入前の寸法は、嵌合凹部82の内周面84の直径の圧入前の寸法より大きくされている。

【0017】嵌合突部132が嵌合凹部82に圧入されるとき、網状突条138が嵌合凹部82の内周面84としまり嵌合するとともに、網状突条138、嵌合凹部82の摩擦熱によって両者が互いに溶着され、第1、第2部材12、130が強固に結合される。また、嵌合突部

132と嵌合凹部82との隙間が周方向において連続して塞がれる。

【0018】なお、上記各実施形態において、円環状突条90、118および網状突条138は、第2部材16、110、130に設けられていたが、嵌合凹部を有する第1部材に設けてもよい。例えば、図5に示す第1部材140の嵌合凹部142の内周面144全体には、複数のシール用突条たる円環状突条146が設けられている。これら円環状突条146は、嵌合凹部142と、第2部材148の嵌合突部150との嵌合方向に直角な平面に沿って形成されており、断面形状が真円状を成し、周方向において連続して閉じており、嵌合突部150と嵌合凹部142との嵌合方向に間隔をあけて形成されている。これら複数個の円環状突条146の各内径の嵌合突部150の圧入前寸法は、全部同じであって、嵌合突部150の直径の圧入前寸法より小さくされている。

【0019】嵌合突部150の嵌合凹部142への圧入時には、円環状突条146が嵌合突部150としまり嵌合するとともに、両者の摩擦熱によって互いに溶着され、第1、第2部材140、148が強固に結合されるとともに、嵌合突部150と嵌合凹部142との隙間が周方向において連続して塞がれる。

【0020】図1および図2に示す実施形態において円環状突条は1個設けるのみでもよい。例えば、図6に示すように、第2部材160の嵌合突部162の先端（第1部材の嵌合凹部に先に嵌合される端）からやや離れた位置であって、嵌合突部162の基端部に、円環状突条164を1個設ける。また、第1部材166の嵌合凹部168は、開口部の径が底部より大きい段付状とする。嵌合突部162の外周面170の円環状突条164が設けられていない先端部の直径は、嵌合凹部168の大径凹部172の内周面174の直径より小さく、小径凹部176の内周面178の直径より大きくされている。また、円環状突条164の外径は、大径凹部172の内周面174の直径より大きくされている。これらの寸法はいずれも、圧入前の寸法である。

【0021】嵌合突部162の嵌合凹部168への圧入時には、まず、嵌合突部162の円環状突部164が設けられていない先端部が小径凹部176に圧入され、それにより、第2部材160の軸線に対する傾きが防止される。次いで、円環状突条164が大径凹部172に圧入されることにより、シールが為される。嵌合突部162の先端部は、大径凹部172の内周面174には食い込むことなく通過して小径凹部176に圧入される。円環状突条164は、嵌合突部162の先端部と擦り合わず、荒らされていない大径凹部172の内周面174に食い込み、しまり嵌合するとともに、摩擦熱によって互いに溶着され、シールが良好に為される。嵌合凹部の開口部を大径部とする代わりに、開口側ほど直径が漸増す

るテーパ開口部としてもよい。

【0022】なお、図1および図2に示す実施形態において、嵌合凹部の内周面の、嵌合突部の圧入前の直径は、軸方向において均一にされていたが、嵌合凹部の内周面を、圧入前の直径が開口から遠ざかるほど小さくなる微小なテーパ値のテーパ内周面としてもよい。嵌合突部には、例えば、その先端近傍部と、先端から離れた位置との2箇所に円環状突条を設け、これら円環状突条の外径はいずれも同じとする。嵌合突部の嵌合凹部への圧入時には、嵌合突部の先端側の円環状突条は、嵌合凹部の内周面の開口側の部分から、その内周面と全周において擦れ合いながら嵌合され、嵌合突部の先端から離れた位置に設けられた円環状突条は、圧入の終了に近い時点において嵌合凹部に嵌合され、嵌合凹部の内周面と全周において擦れ合う。そのため、先端側の円環状突条の方が、嵌合凹部の内周面との擦れ合いによる摩耗量が多いが、嵌合凹部の内周面を上記のようなテーパ内周面としておくことにより、嵌合突部の先端側の円環状突条は嵌合凹部の嵌合限度位置（嵌合突部が進入する開口から遠い側の嵌合端）近傍の部分としまり嵌合し、他方の円環状突条は、嵌合凹部の開口側の内周面としまり嵌合し、同じしめ代で圧入され、同じ状態で溶着されるようにすることができる。また、複数の円環状突条90の各外径の圧入前の寸法は、全部同じにされていたが、互いに異ならせてもよい。例えば、嵌合突部の先端近傍部と、先端から離れた位置との2箇所にそれぞれ円環状突条を設けるとともに、先端側の円環状突条の外径を他方より大きくするのである。なお、嵌合凹部の内周面の圧入前の直径は、軸方向において均一とする。嵌合突部が嵌合凹部に圧入されるとき、嵌合突部の先端側の円環状突条は、先端から離れて設けられた円環状突条よりも、嵌合凹部の内周面との擦れ合いが多く、摩耗量が多いが、外径を大きくしておくことにより、2個の円環状突条がほぼ均一なしめ代で嵌合凹部に圧入され、同じ状態で溶着されるようにすることができる。これらの場合、いずれも、円環状突条を3個以上、軸方向において間隔を隔てて設けてもよい。嵌合凹部の内周面の直径を軸方向において均一にするのであれば、円環状突条の外径は、嵌合突部の先端側の円環状突条ほど大きくなるようにすることが望ましい。また、嵌合凹部の内周面を開口から離れるほど直径が小さくなるテーパ内周面とするとともに、複数の円環状突条の外径を、嵌合突部の先端側の円環状突条ほど小さくしてもよい。この場合、複数の円環状突条がそれぞれ同じしめ代で嵌合凹部に圧入されるとき、同じ状態で溶着されるように、円環状突条の外径寸法、嵌合凹部の内径寸法を設定することが望ましい。嵌合突部の嵌合凹部への圧入時に、嵌合突部の先端側の円環状突条は、嵌合凹部の嵌合限度位置近傍に至るまで、嵌合凹部の内周面と全周において擦れ合うことなく嵌合され、嵌合凹部の嵌合限度位置近傍において内

周面と全周において擦れ合って摩耗しつつ圧入され、嵌合突部の先端から遠い側の円環状突条は、圧入の終了に近い時点で嵌合凹部の内周面と擦れ合いながら圧入されて、複数の円環状突条がほぼ同じ量摩耗し、実質的に同じしめ代で圧入されるようにすることが望ましいのである。

【0023】さらに、図3に示す実施形態においてシール用突条は1個設けるのみでもよい。また、図4に示す実施形態において、第2部材の嵌合突部に網状突条を設けてシール用突条として機能させる場合も、事情は嵌合突部に円環状突条を設ける場合とほぼ同じであり、円環状突条を設ける場合と同様に種々の態様を取り得る。

【0024】また、上記各実施形態に記載の各特徴は互いに組み合わせることで実施することが可能である。例えば、図4に示す実施形態において網状の突条を設けるとともに、それより先端側に嵌合方向に平行に延びる突条を設けてもよい。また、嵌合凹部の内周面にシール用突条を設ける場合、開口側のシール用突条ほど、内径を小さくしたり、嵌合突部の直径を、先端側ほど小さくしてもよい。

【0025】その他、特許請求の範囲を逸脱することなく、当業者の知識に基づいて種々の変形、改良を施した態様で本発明を実施することができる。

【図面の簡単な説明】

【図1】本発明の一実施形態である慣性圧入方法の実施に好適な慣性圧入装置を示す側面断面図である。

【図2】上記慣性圧入装置において互いに圧入される第1部材および第2部材を概念的に示す図である。

【図3】本発明の別の実施形態である慣性圧入方法により圧入される第1部材および第2部材を概念的に示す図である。

【図4】本発明の更に別の実施形態である慣性圧入方法により圧入される第1部材および第2部材を概念的に示す図である。

【図5】本発明の更に別の実施形態である慣性圧入方法により圧入される第1部材および第2部材を概念的に示す図である。

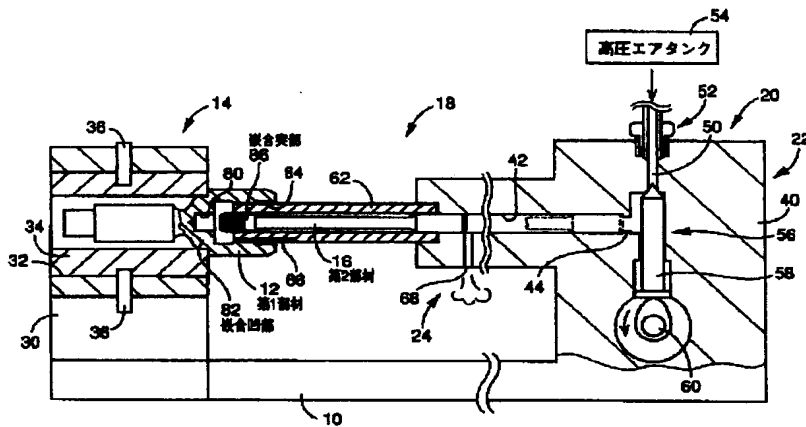
【図6】本発明の更に別の実施形態である慣性圧入方法により圧入される第1部材および第2部材を概念的に示す図である。

【符号の説明】

12：第1部材	16：第2部材	82：嵌合凹部
84：内周面		
86：嵌合突部	88：外周面	90：円環状突条
100：第1部材		
102：嵌合凹部	110：第2部材	112：嵌合突部
114：外周面	116：突条	118：円環状突条
120、122：内周面	130：第2部材	132：嵌合突部
134：外周面	136：凹部	

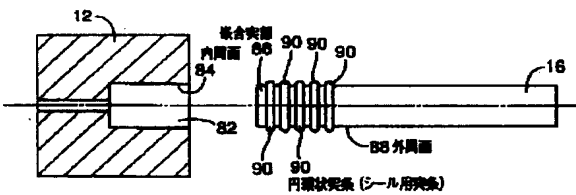
138: 網状突条 140: 第1部材 142: 嵌
合凹部 144: 内周面 146: 円環状突条
148: 第2部材 150: 嵌合突部 160: 第
2部材 162: 嵌合突部 164: 円環状突条
166: 第1部材 168: 嵌合凹部 170:
外周面 174, 178: 内周面

【図1】

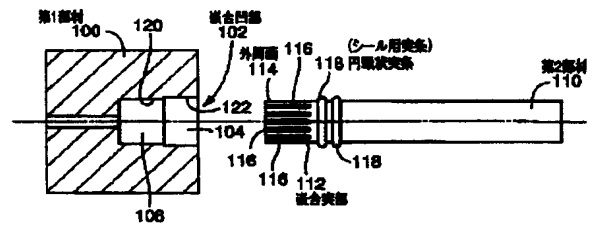


【図2】

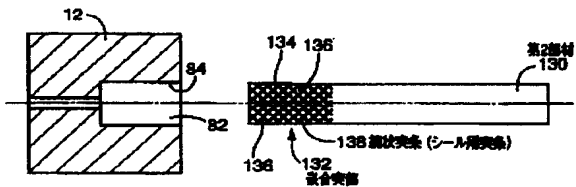
【図3】



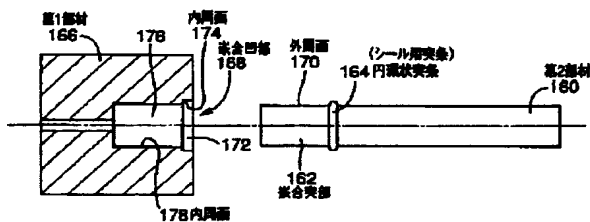
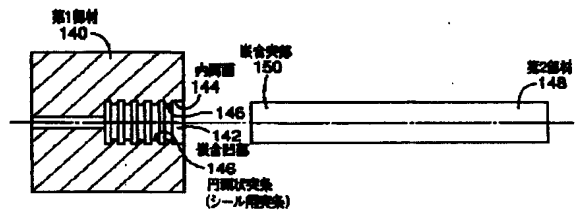
【図4】



【図5】



【図6】



フロントページの続き

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